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Zeidman

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(54) **DETECTING PLAGIARISM IN COMPUTER SOURCE CODE**

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(51) **Int. Cl.**
G06F 9/44 (2006.01)

(52) **U.S. Cl.** **717/123**; 434/367; 726/32

(58) **Field of Classification Search** ..... None
See application file for complete search history.

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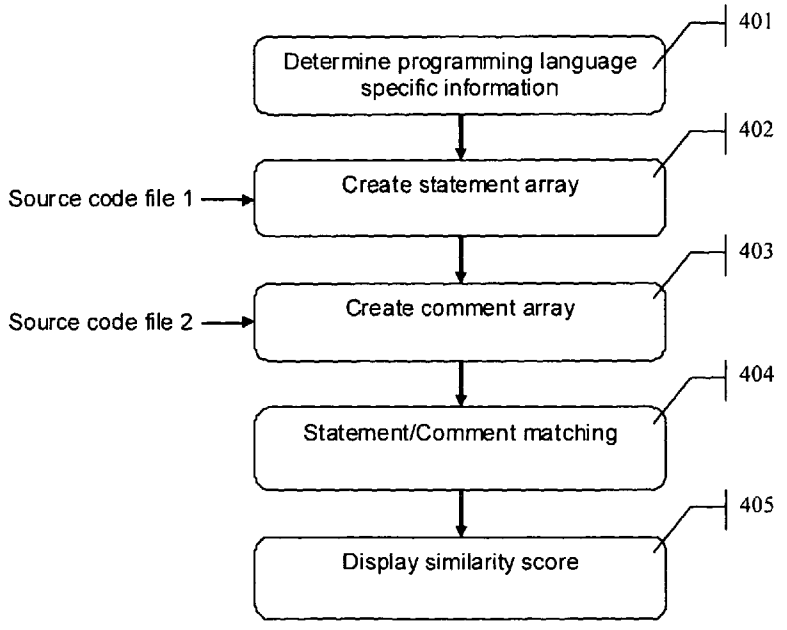
(57) **ABSTRACT**

Plagiarism of software source code is a serious problem in two distinct areas of endeavor—cheating by students at schools and intellectual property theft at corporations. A number of algorithms have been implemented to check source code files for plagiarism, each with their strengths and weaknesses. This invention detects plagiarism by comparing statements within source code of a first program to comments within source code of a second program.

9 Claims, 6 Drawing Sheets



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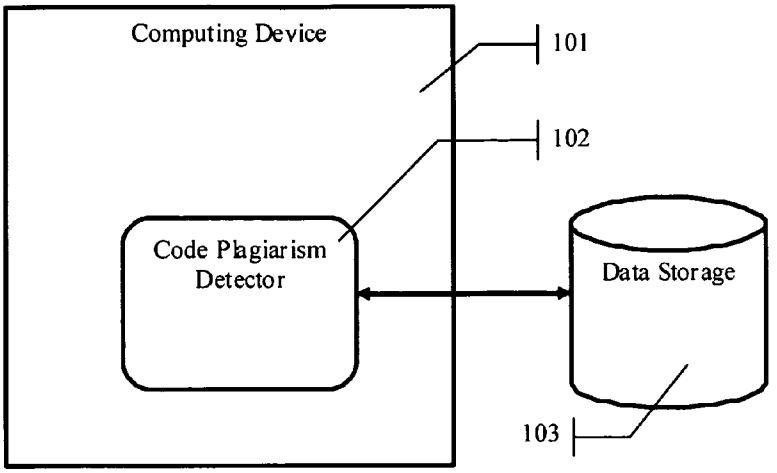

Figure 1

```
/*    fdiv routine
      This routine is important   */
void fdiv(
    char    *fname,      // file name
    char *path)          // path
{                                        201
    int Index1, j;
    printf("hello world");
    while (1)
        j =    strlen(fname);
    /* find the file     extension */
```

Figure 2A

```
Statement1[0] = "void fdiv"                Comment1[0] = "fdiv routine"
Statement1[1] = "char fname"               Comment1[1] = "This routine is important"
Statement1[2] = "char path"                Comment1[2] = "find the file extension"
Statement1[3] = "int Index1 j"
Statement1[4] = "while 1"
Statement1[5] = "j strlen fname"
                          202                              203
```

Figure 2B

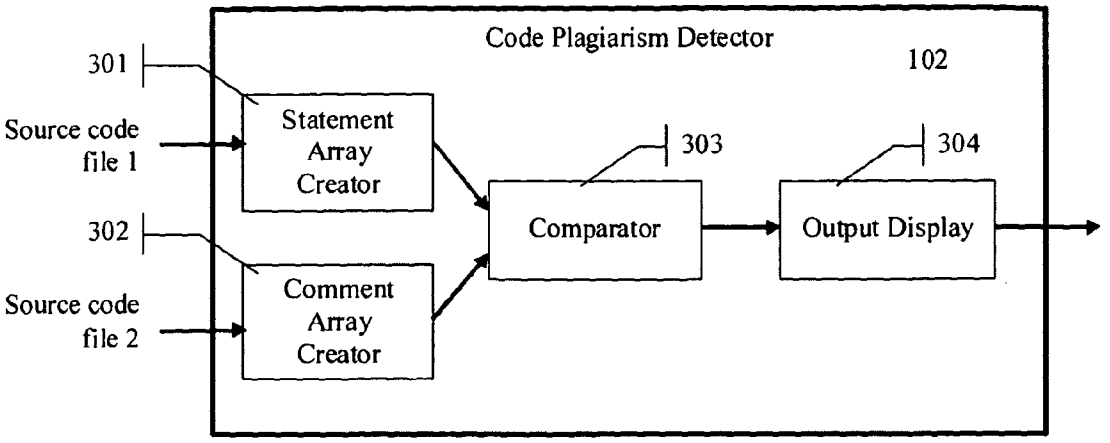

Figure 3

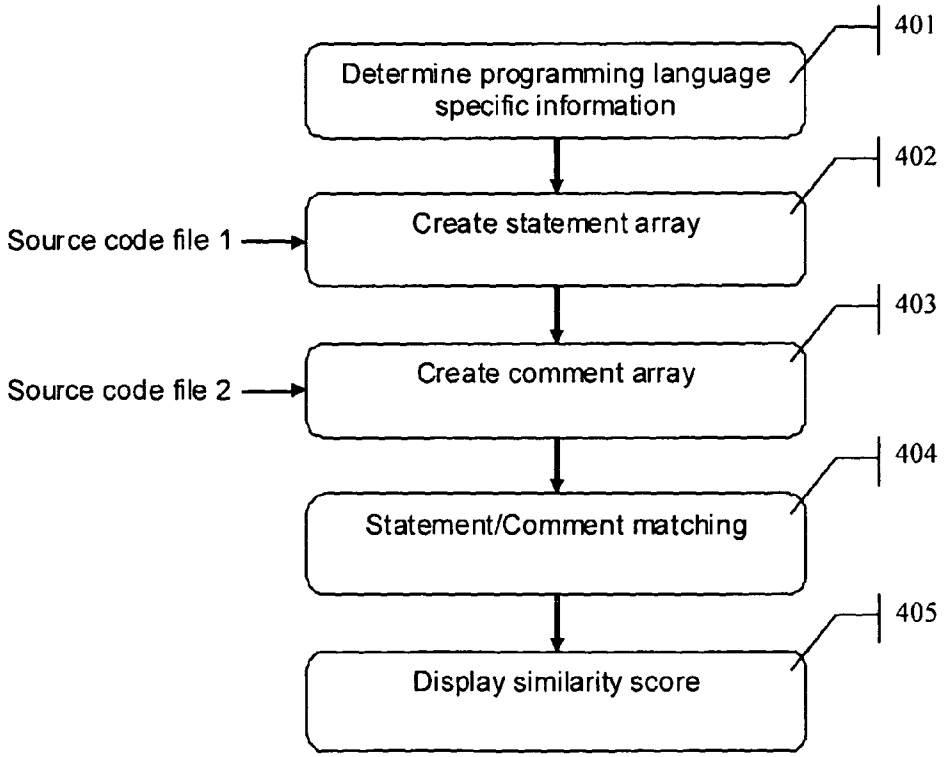

Figure 4

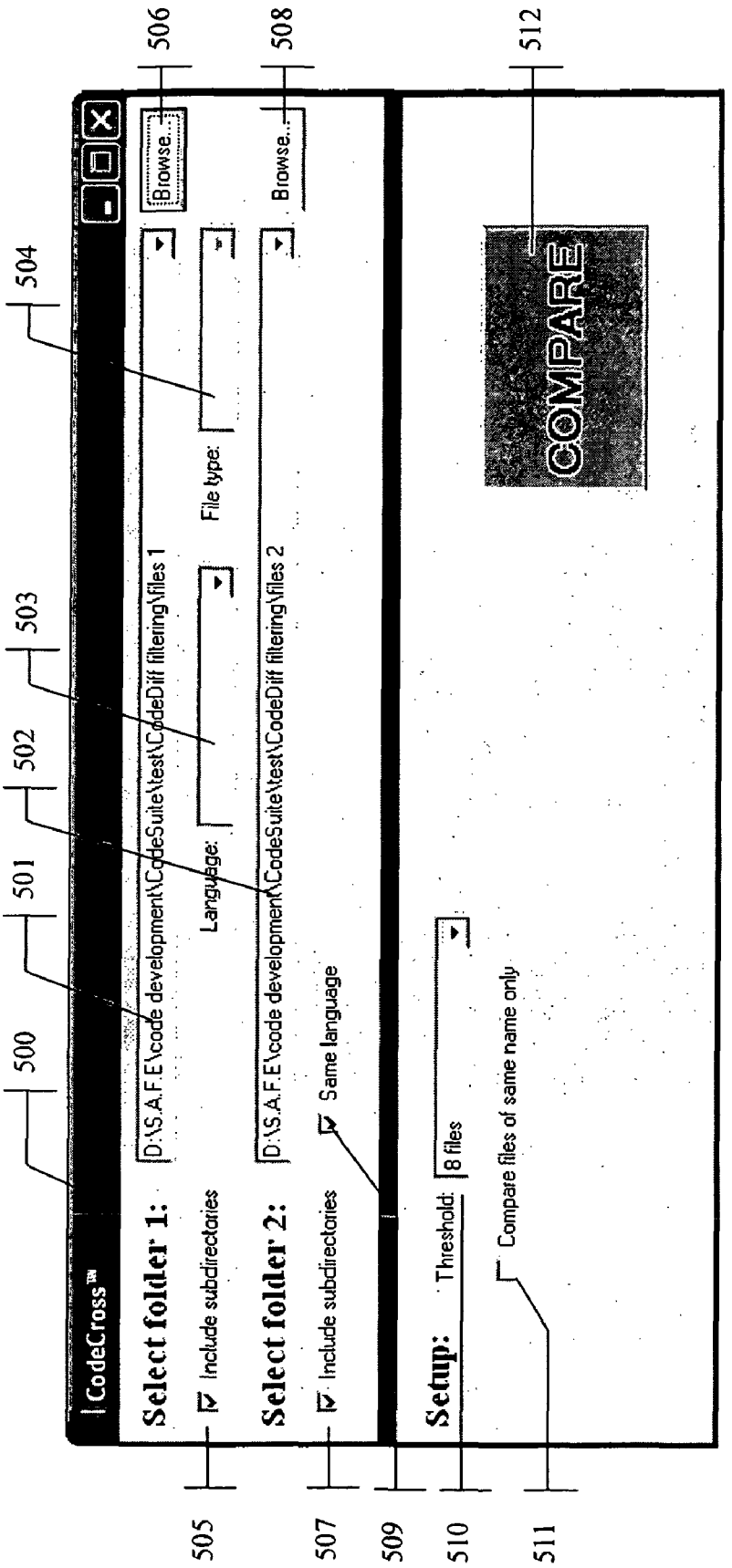
CodeCross
Select folder 1:
D:\S.A.F.E\code development\CodeSuite\test\CodeDiff filtering\files 1
Browse...
Include subdirectories
Language:
File type:
Select folder 2:
D:\S.A.F.E\code development\CodeSuite\test\CodeDiff filtering\files 2
Browse...
Include subdirectories
Same language
Setup:
Threshold:
8 files
Compare files of same name only
COMPARE
500
501
502
503
504
505
506
507
508
509
510
511
512

Figure 5

CodeCross Basic Report 600
Version: 1.0.0 601
Date: 11/22/08
Time: 13:09:09

CodeSuite copyright 2003-2008 by Software Analysis and Forensic Engineering Corporation

SETTINGS

Compare files in folder D:\S.A.F.E\code development\CodeSuite\test\CodeCross\files 1
Including subdirectories
To files in folder D:\S.A.F.E\code development\CodeSuite\test\CodeCross\files 2
Including subdirectories
Programming language: C 602
Filetypes: *.c;*.h
Reporting file threshold: 8 files

D:\S.A.F.E\code development\CodeSuite\test\CodeCross\files 1\aaa_commented.c

Score Compared To File 603

100 D:\S.A.F.E\code development\CodeSuite\test\CodeCross\files 2\aaa.c
100 D:\S.A.F.E\code development\CodeSuite\test\CodeCross\files 2\aaa_with_comments.c
100 D:\S.A.F.E\code development\CodeSuite\test\CodeCross\files 2\abc.c
100 D:\S.A.F.E\code development\CodeSuite\test\CodeCross\files 2\bpf_dump_semicolons.c
100 D:\S.A.F.E\code development\CodeSuite\test\CodeCross\files 2\bpf_dump_strings.c
100 D:\S.A.F.E\code development\CodeSuite\test\CodeCross\files 2\semicolon_test.c

D:\S.A.F.E\code development\CodeSuite\test\CodeCross\files 1\bpf_dump.c

Score Compared To File 604

100 D:\S.A.F.E\code development\CodeSuite\test\CodeCross\files 2\bpf_dump_strings.c
100 D:\S.A.F.E\code development\CodeSuite\test\CodeCross\files 2\W32NReg_commented.c

Figure 6A

610

Comparing file1:
D:\S.A.F.E\code development\CodeSuite\test\CodeCross\files 1\aaa_commented.c
To file2:
D:\S.A.F.E\code development\CodeSuite\test\CodeCross\files 2\aaa.c

611

Matching statements to comments:

File1 Line#	File2 Line#	Comment/String
1 4	1 3 5	p = null;
2 5	2	private String auxonus = null;

612

Figure 6B

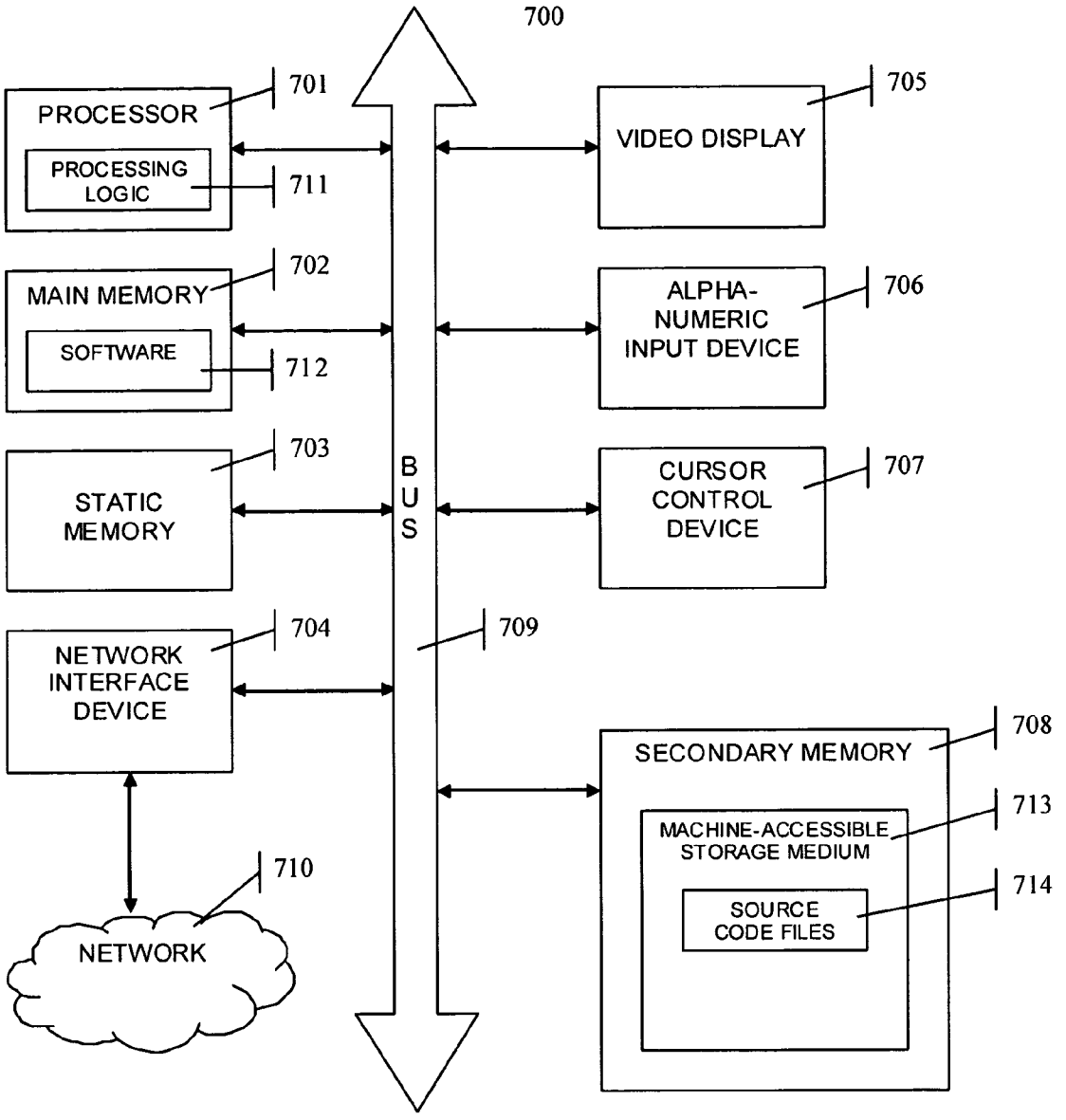
700
PROCESSOR
701
PROCESSING LOGIC
711
MAIN MEMORY
702
SOFTWARE
712
STATIC MEMORY
703
NETWORK INTERFACE DEVICE
704
709
710
NETWORK
BUS
VIDEO DISPLAY
705
ALPHA-NUMERIC INPUT DEVICE
706
CURSOR CONTROL DEVICE
707
SECONDARY MEMORY
708
MACHINE-ACCESSIBLE STORAGE MEDIUM
713
SOURCE CODE FILES
714

Figure 7

DETECTING PLAGIARISM IN COMPUTER SOURCE CODE

RELATED APPLICATIONS

The present application is a continuation-in-part application of U.S. patent application Ser. No. 10/720,636 filed Nov. 25, 2003 now U.S. Pat. No. 7,503,035, which is incorporated herein by reference.

TECHNICAL FIELD

Embodiments of the present invention relate to software tools for comparing program source code files to detect code copied from one file to another. In particular, the present invention relates to finding pairs of source code files that have been copied, in full or in part, by detecting functional code in one file that has been commented out in another file.

BACKGROUND

Plagiarism detection programs and algorithms have been around for a number of years but have gotten more attention recently due to two main factors. First, the Internet and search engines like Google have made source code very easy to obtain. Second, the open source movement has grown tremendously over the past several years, allowing programmers all over the world to write, distribute, and share code.

In recent years, plagiarism detection techniques have become more sophisticated. A summary of available tools is given by Paul Clough in his paper entitled "Plagiarism in natural and programming languages: an overview of current tools and technologies." Clough discusses tools and algorithms for finding plagiarism in generic text documents as well as in programming language source code files.

There are a number of plagiarism detection programs currently available including the Plague program developed by Geoff Whale at the University of New South Wales, the YAP programs (YAP, YAP2, YAP3) developed by Michael Wise at the University of Sydney, Australia, the JPlag program, written by Lutz Prechelt and Guido Malpohl of the University Karlsruhe and Michael Philippsen of the University of Erlangen-Nuremberg, and the Measure of Software Similarity (MOSS) program developed at the University of California at Berkeley by Alex Aiken.

One deficiency of the aforementioned programs is that they only compare functional code. One program, CodeMatch®, developed by Robert Zeidman, the inventor of the present invention, overcomes this deficiency by dividing program source code into elements including functional code (statements, identifiers, and instruction sequences) and non-functional code (comments and strings) and compares these different elements in the source code files of different programs to each other.

Clever programmers will often make significant changes to the appearance, but not the functionality, of the functional source code in order to disguise copying. The resulting functional code looks very different but functions identically to the original code from which it was copied.

In cases of trying to disguise copying, a programmer may copy a function from one program's source code into another program's source code and comment it out in order to use the code as a guide for writing a similar function. Often programmers making changes to disguise functional statements do not make changes to the commented code because it is non-functional and escapes their notice. All of the previously mentioned tools will not find this sure sign of plagiarism.

Accordingly, it would be beneficial to have a plagiarism detection tool that can compare functional code in one source code file to nonfunctional code in another source code file in order to overcome the above limitations of the conventional techniques.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example, and not by way of limitation, in the figures of the accompanying drawings and in which:

FIG. **1** illustrates a block diagram of a system for the present invention, in accordance with one embodiment of the invention.

FIG. **2** illustrates dividing a file of source code into statements and comments.

FIG. **3** illustrates the software architecture of one embodiment of the present invention.

FIG. **4** illustrates a flow diagram of one embodiment of the present invention.

FIG. **5** illustrates a user interface of one embodiment of the invention.

FIG. **6** illustrates a basic report and a detailed report, output in accordance with one embodiment of the invention.

FIG. **7** illustrates a block diagram of an exemplary computer system, in accordance with one embodiment of the invention.

DETAILED DESCRIPTION

Methods and systems for detecting copied program code based on source code are described. In one embodiment, signs of possible copying are detected by comparing source code functional statements of a first program with source code non-functional comments of a second program suspected of being copied from the first program.

Embodiments of the invention make use of a basic knowledge of programming languages and program structures to simplify the matching task, while requiring a small amount of programming language-specific information. Such programming language-specific information includes characters used to delimit comments in the particular programming language.

In the following description, numerous details are set forth. It will be apparent, however, to one skilled in the art, that the present invention may be practiced without these specific details. In some instances, well-known structures and devices are shown in block diagram form, rather than in detail, in order to avoid obscuring the present invention.

Some portions of the detailed descriptions which follow are presented in terms of algorithms and symbolic representations of operations on data bits within a computer memory. These algorithmic descriptions and representations are the means used by those skilled in the data processing arts to most effectively convey the substance of their work to others skilled in the art. An algorithm is here, and generally, conceived to be a self-consistent sequence of steps leading to a desired result. The steps are those requiring physical manipulations of physical quantities. Usually, though not necessarily, these quantities take the form of electrical or magnetic signals capable of being stored, transferred, combined, compared, and otherwise manipulated. It has proven convenient at times, principally for reasons of common usage, to refer to these signals as bits, values, elements, symbols, characters, terms, numbers, or the like.

It should be borne in mind, however, that all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to

these quantities. Unless specifically stated otherwise, as apparent from the following discussion, it is appreciated that throughout the description, discussions utilizing terms such as "communicating", "executing", "passing", "determining", "generating", or the like, refer to the action and processes of a computer system, or similar electronic computing device, that manipulates and transforms data represented as physical (electronic) quantities within the computer system's registers and memories into other data similarly represented as physical quantities within the computer system memories or registers or other such information storage, transmission or display devices.

The present invention also relates to an apparatus for performing the operations herein. This apparatus may be specially constructed for the required purposes, or it may comprise a general purpose computer selectively activated or reconfigured by a computer program stored in the computer. Such a computer program may be stored in a computer readable storage medium, such as, but not limited to, any type of disk including floppy disks, optical disks, CD-ROMs, and magnetic-optical disks, read-only memories (ROMs), random access memories (RAMs), EPROMs, EEPROMs, magnetic or optical cards, or any type of media suitable for storing electronic instructions, each coupled to a computer system bus.

The algorithms and displays presented herein are not inherently related to any particular computer or other apparatus. Various general purpose systems may be used with programs in accordance with the teachings herein, or it may prove convenient to construct more specialized apparatus to perform the required method steps. The required structure for a variety of these systems will appear as set forth in the description below. In addition, the present invention is not described with reference to any particular programming language. It will be appreciated that a variety of programming languages may be used to implement the teachings of the invention as described herein.

The present invention may be provided as a computer program product, or software, that may include a machine-accessible medium having stored thereon instructions, which may be used to program a computer system (or other electronic devices) to perform a process according to the present invention. A machine-accessible medium includes any mechanism for storing or transmitting information in a form readable by a machine (e.g., a computer). For example, a machine-accessible (e.g., computer-readable) medium includes a machine (e.g., a computer) readable storage medium (e.g., read only memory ("ROM"), random access memory ("RAM"), magnetic disk storage media, optical storage media, flash memory devices, etc.), a machine (e.g., computer) readable transmission medium (electrical, optical, acoustical or other form of propagated signals (e.g., carrier waves, infrared signals, digital signals, etc.), etc.

FIG. **1** illustrates a block diagram of a system for detecting program code plagiarism in accordance with one embodiment of the invention. The system includes a computing device **101** and a data storage device **103**. The data storage device **103** may be a mass storage device, such as a magnetic or optical storage based disk or tape, and may be part of the computing device **101**, or be coupled with the computing device **101** directly or via a network (e.g., a public network such as the Internet or a private network such as a local area network (LAN)). The computing device **101** may be a personal computer (PC), palm-sized computing device, personal digital assistant (PDA), server, or other computing device.

The computer device **101** hosts a code plagiarism detector **102** that can detect plagiarism by examining source code of two different programs. The code plagiarism detector **102** detects plagiarism by comparing a first computer program source code file with a second computer program source code file. The files being compared may be stored in the data storage device **103**.

In one embodiment, the code plagiarism detector **102** preprocesses the files being compared prior to performing the comparison. As will be discussed in more detail below, the code plagiarism detector **102** may create data structures (e.g., arrays) for the files being compared, and may store the data structures in the data storage **103**. The code plagiarism detector **102** may then compare entries of the data structures, and calculate a similarity score based on the number of similar entries in the data structures, where the similarity score indicates a possibility of plagiarism. The code plagiarism detector **102** may generate a report and store it in the data storage **103** or display it to a user of the computing device **101** or some other computing device coupled to the device **101** (e.g., directly or via a network).

In one embodiment of the present invention, each line of two source code files is initially examined and a string array for each file is created: Statements**1**[ ] is the collection of functional statements in the first file and Comments**2**[ ] is the collection of non-functional comments in the second file. A sample snippet **201** of a source code file to be examined is shown in FIG. **2**A. The array of statements **202** and comments **203** for the code snippet **201** is shown in FIG. **2**B. Note that whitespace is not removed entirely, but rather all sequences of whitespace characters are replaced by a single space in both source lines and comment lines. In this way, the individual words are preserved in the strings. Separator characters such as {, }, and ; are treated as whitespace. The comment characters themselves, in this case /*, */, and //, are stripped off from the comments. Special characters such as comment delimiters and separator characters are defined in a language definition file that is input to this embodiment of the present invention.

FIG. **3** illustrates a block diagram of one embodiment of a code plagiarism detector **102** that compares a source code file of a first program with a source code file of a second program. The code plagiarism detector **102** includes statement array creator **301**, comment array creator **302**, comparator **303**, and output display **304**.

The statement array creator **301** examines lines of the source code file and creates a statement array. The statement array includes functional statements that are found in the source code. The comment array creator **302** examines lines of the source code file and creates a comment array. The comment array includes non-functional comments that are found in the source code. The comparator **303** compares the statements in the statement array to the comments in the comment array. The output display **304** takes the output of the comparator **303** and displays it to the user.

The comment array creator **302** uses a predefined list of special characters, which is programming language specific, to correctly determine the beginning and end of comments in the code in order to construct the comment array. For example, the source code file snippet **201** includes double slash characters (//) that are used to denote comments that start after the double slash and continue until the end of the line. The source code file snippet **201** also include the /* character sequence to denote the beginning of a comment and the */ character sequence to denote the end of a comment.

Once the array creators **301** and **302** create their respective arrays, the comparator **303** performs the comparison using these arrays. The comparator **303** compares each entry in the string array to each entry in the comment array. When source

code is copied, functional statements are sometimes commented out and used as a guide for writing new code. Hence copied source code may contain statements that have been commented out.

This comparator **303** calculates a similarity score based on the number of statements in the first file that are similar to comments in the second file. In one embodiment, similar strings consist of exact matches. In other words, the number of matching statements and comments includes only statements and comments where each and every character in the string exactly matches the corresponding character in the text sequence.

In another embodiment, similarity score s can represent the number of matching statements and comments in the pair of arrays weighted by the number of characters in the matching lines and can be determined using the following equation:

$$s=\Sigma A_i \text{ for } i=1 \text{ to } m_s$$

where m_s is the number of matching statements and A_i is the number of matching characters in matching statements i.

In another embodiment, similar statements and comments are not limited to exact matches and also include partial matches. It may be that in the copied source code, the statements were commented out, but in the original source code the statements went through further changes after the source code was copied. Hence, this other embodiment considers partial matches where the distance between a string and a comment is below some predefined threshold. This distance can be some well-known distance measure such as the Levenshtein distance (also known as the edit distance), the Damerau-Levenshtein distance, or the Hamming distance.

In yet another embodiment, a similarity score can be calculated as a binary value of 0 or 1. If there is at least one statement in the first source code file that is similar to one comment in the second source code file, the similarity score is 1 otherwise it is 0. This can be done because just the fact that a single statement in the first program appears as a comment in the second program is enough reason to warrant further examination. This binary calculation does not make a value judgment about the commenting, but simply directs a user to look more carefully at this suspicious phenomenon.

The output display **304** generates an output to a user such as a report that may include a list of file pairs ordered by the result of the similarity score calculated by comparator **303**, as will be discussed in more detail below.

FIG. **4** illustrates a flow diagram of one embodiment of a method of detecting source code plagiarism. The method may be performed by processing logic that may comprise hardware (e.g., circuitry, programmable logic, microcode, etc.), software (such as instructions run on a processing device), or a combination thereof. In one embodiment, the method is performed by a code plagiarism detector (e.g., code plagiarism detector **102** of FIG. **1**).

Referring to FIG. **4**, the method begins with processing logic determining program language dependant information (block **401**). Program language dependant information may include, for example, comment delimiter characters. Program language dependant information may be hard-coded or provided by a user.

At block **402**, processing logic creates a statement array for a source code file of a first program. At block **403**, processing logic creates a comment array for a source code file of a second program. Processing logic at blocks **402** and **403** may create the above arrays using the program language dependant information.

At block **404**, processing logic compares the statement array of the first source code file to the comment array of the second source code file, and creates a list of similar strings. Processing logic uses the number of similar statements and comments to generate a similarity score.

At block **405** processing logic generates a report based on the comparison.

FIG. **5** shows one embodiment of a user interface for the present invention. The user interface screen **500** contains a number of fields for accepting user input. Folder**1** field **501** allows the user to type a path to a folder containing source code files of the original program to be compared. Alternatively, the user can click on browse button **506** that will allow the user to browse folders and select one that will be automatically entered into folder**1** field **501**. The user selects a programming language from the drop-down list **503** of known computer programming languages. The user selects a file type or list of file types containing source code from drop-down list **504**. Alternatively the user can type a file type or list of file types into field **504**. If the user checks checkbox **505**, source code files in all subdirectories of folder**1** will also be considered as part of the original program and will be used in the comparison.

Folder**2** field **502** allows the user to type a path to a folder containing source code files of the suspected copied program to be compared. Alternatively, the user can click on browse button **508** that will allow the user to browse folders and select one that will be automatically entered into folder**2** field **502**. If the user checks checkbox **507**, source code files in all subdirectories of folder**2** will also be considered as part of the suspected copied program and will be used in the comparison. If the user checks checkbox **509**, the programming language selected in drop-down list **503** and file types specified in field **504** will also be used for the files specified in folder**2**. If the user does not check checkbox **509**, another language drop-down box and file type field will appear, allowing the user to specify a different programming language and different file types to be considered for the second set of files.

Threshold dropdown box **510** allows a user to select how many files to be reported. For example, if a user selects a threshold of 8 files and 9 files in folder**2** have comments that are similar to statements in a file in folder**1**, only the 8 files with the highest similarity scores will be reported. It may be necessary to arbitrarily choose among the files to be displayed if, for example, files **8** and **9** have the same similarity score. The threshold is used to limit the size of the reports that are generated.

If checkbox **511** is checked, then the comparison only compares a file in folder**2** that has the same name as a file in folder**1**. This is done because sometimes file names are not changed when they are copied. This speeds up the comparison process but will miss cases where file names have been changed or code was moved from one file to another.

The user clicks on compare button **512** to begin the comparison process.

FIG. **6**A and FIG. **6**B illustrate sample reports generated by one embodiment of the present invention, indicating possible plagiarism. Referring to FIG. **6**A, an HTML output report **600** includes a list of file pairs ordered by their total correlation scores. The report **600** includes a report description **601**, a header **602** showing the chosen settings, and rankings of file pair matches **603** and **604** based on their similarity scores. Each correlation score on the left in sections **603** and **604** is also a hyperlink to a detailed report for that particular file pair.

FIG. **6**B illustrates a detailed report **610** showing similar statements and comments in a specific file pair. In this way, experts are directed to suspicious similarities and allowed to

make their own judgments. The detailed report **610** includes a header **611** that tells which files are being compared. Furthermore, the detailed report includes a detailed description of the statements in file**1** that matched comments in file**2** as shown in the table **612**.

FIG. **7** illustrates a diagrammatic representation of a machine in the exemplary form of a computer system **700** within which a set of instructions, for causing the machine to perform any one or more of the methodologies discussed herein, may be executed. In alternative embodiments, the machine may be connected (e.g., networked) to other machines in a Local Area Network (LAN), an intranet, an extranet, or the Internet. The machine may operate in the capacity of a server or a client machine in a client-server network environment, or as a peer machine in a peer-to-peer (or distributed) network environment. The machine may be a personal computer (PC), a tablet PC, a set-top box (STB), a Personal Digital Assistant (PDA), a cellular telephone, a web appliance, a server, a network router, switch or bridge, or any machine capable of executing a set of instructions (sequential or otherwise) that specify actions to be taken by that machine. Further, while only a single machine is illustrated, the term "machine" shall also be taken to include any collection of machines (e.g., computers) that individually or jointly execute a set (or multiple sets) of instructions to perform any one or more of the methodologies discussed herein.

The exemplary computer system **700** includes a processor **701**, a main memory **702** (e.g., read-only memory (ROM), flash memory, dynamic random access memory (DRAM) such as synchronous DRAM (SDRAM) or Rambus DRAM (RDRAM), etc.), a static memory **703** (e.g., flash memory, static random access memory (SRAM), etc.), and a secondary memory **708** (e.g., a data storage device), which communicate with each other via a bus **709**.

Processor **701** represents one or more general-purpose processing devices such as a microprocessor, central processing unit, or the like. More particularly, the processor **701** may be a complex instruction set computing (CISC) microprocessor, reduced instruction set computing (RISC) microprocessor, very long instruction word (VLIW) microprocessor, processor implementing other instruction sets, or processors implementing a combination of instruction sets. Processor **701** may also be one or more special-purpose processing devices such as an application specific integrated circuit (ASIC), a field programmable gate array (FPGA), a digital signal processor (DSP), network processor, or the like. Processor **701** is configured to execute the processing logic **711** for performing the operations and steps discussed herein.

The computer system **700** may further include a network interface device **704**. The computer system **700** also may include a video display unit **705** (e.g., a liquid crystal display (LCD) or a cathode ray tube (CRT)), an alphanumeric input device **706** (e.g., a keyboard), and a cursor control device **707** (e.g., a mouse).

The secondary memory **708** may include a machine-accessible storage medium (or more specifically a machine-accessible storage medium) **713** on which is stored one or more sets of instructions embodying any one or more of the methodologies or functions described herein. The software **712** may reside, completely or at least partially, within the main memory **702** and/or within the processor **701** during execution thereof by the computer system **700**, the main memory **702** and the processor **701** also constituting machine-accessible storage media. The software **712** may further be transmitted or received over a network **710** via the network interface device **704**.

The machine-accessible storage medium **708** may also be used to store source code files **714**. While the machine-accessible storage medium **713** is shown in an exemplary embodiment to be a single medium, the term "machine-accessible storage medium" should be taken to include a single medium or multiple media (e.g., a centralized or distributed database, and/or associated caches and servers) that store the one or more sets of instructions. The term "machine-accessible storage medium" shall also be taken to include any medium that is capable of storing or encoding a set of instructions for execution by the machine and that cause the machine to perform any one or more of the methodologies of the present invention. The term "machine-accessible storage medium" shall accordingly be taken to include, but not be limited to, solid-state memories, and optical and magnetic media.

It is to be understood that the above description is intended to be illustrative, and not restrictive. Many other embodiments will be apparent to those of skill in the art upon reading and understanding the above description. Although the present invention has been described with reference to specific exemplary embodiments, it will be recognized that the invention is not limited to the embodiments described, but can be practiced with modification and alteration within the spirit and scope of the appended claims. Accordingly, the specification and drawings are to be regarded in an illustrative sense rather than a restrictive sense. The scope of the invention should, therefore, be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled.

I claim:

1. A computer-implemented method comprising:

creating, by a computer system, a first array of lines of functional program code from a first program source code file, the first program source code file including the lines of functional program code of a first program written in a first programming language and lines of non-functional comments of the first program;

creating, by the computer system, a second array of lines of non-functional comments from a second program source code file, the second program source code file including lines of functional program code of a second program written in a second programming language and the lines of non-functional comments of the second program, wherein the first programming language is different from the second programming language, and wherein the second array of non-functional comments is created using a predefined list of programming language specific special characters to determine the beginning and end of comments in the second program source code file;

comparing, by the computer system, the lines of functional program code from the first array with the lines of non-functional comments from the second array to find similar lines;

calculating, by the computer system, a similarity number based on the similar lines, wherein calculating the similarity number comprises finding a number of matching functional statements in the first array and non-functional comments in the second array indicating that the non-functional comments of the second program source code file contain functional program code of the first program source code file; and

presenting to a user an indication of copying of the first program source code file wherein said indication of copying is defined by the similarity number.

2. The method of claim 1) wherein:

calculating a similarity number comprises finding a number of matching lines in the first and second arrays weighted by the number of characters in the lines.

3. The method of claim 1) wherein:

calculating a similarity number comprises finding a number of lines in the first and second arrays that have an edit distance less than a given threshold.

4. A computer-readable storage medium storing executable instructions to cause a computer system to perform a method comprising:

creating a first array of lines of functional program code from a first program source code file, the first program source code file including the lines of functional program code of a first program written in a first programming language and lines of non-functional comments of the first program;

creating a second array of lines of non-functional comments from a second program source code file, the second program source code file including lines of functional program code of a second program written in a second programming language and the lines of non-functional comments of the second program, wherein the first programming language is different from the second programming language, and wherein the second array of non-functional comments is created using a predefined list of programming language specific special characters to determine the beginning and end of comments in the second program source code file;

comparing the lines of functional program code from the first array with the lines of non-functional comments from the second array to find similar lines;

calculating a similarity number based on the similar lines, wherein calculating the similarity number comprises finding a number of matching functional statements in the first array and non-functional comments in the second array indicating that the non-functional comments of the second program source code file contain functional program code of the first program source code file; and

presenting to a user an indication of copying of the first program source code file wherein said indication of copying is defined by the similarity number.

5. The computer-readable storage medium of claim 4) wherein:

calculating a similarity number comprises finding a number of matching lines in the first and second arrays weighted by the number of characters in the lines.

6. The computer-readable storage medium of claim 4) wherein:

calculating a similarity number comprises finding a number of lines in the first and second arrays that have an edit distance less than a given threshold.

7. A computer-implemented apparatus comprising:

a computer; and

a source code matching program on the computer, the source code matching program comprising:

means for creating a first array of lines of functional program code from a first program source code file, the first program source code file including the lines of functional program code of a first program written in a first programming language and lines of non-functional comments of the first program;

means for creating a second array of lines of non-functional comments from a second program source code file, the second program source code file including lines of functional program code of a second program written in a second programming language and the lines of non-functional comments of the second program, and wherein the second array of non-functional comments is created using a predefined list of programming language specific special characters to determine the beginning and end of comments in the second program source code file;

means for comparing the lines of functional program code from the first array with the lines of non-functional comments from the second array to find similar lines;

means for calculating a similarity number based on the similar lines, wherein calculating the similarity number comprises finding a number of matching functional statements in the first array and non-functional comments in the second array indicating that the non-functional comments of the second program source code file contain functional program code of the first program source code file; and

means for presenting to a user an indication of copying of the first program source code file wherein said indication of copying is defined by the similarity number.

8. The apparatus of claim 7) wherein:

the means for calculating a similarity number comprises means for finding a number of matching lines in the first and second arrays weighted by the number of characters in the lines.

9. The apparatus of claim 7) wherein:

the means for calculating a similarity number comprises finding a number of lines in the first and second arrays that have an edit distance less than a given threshold.

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